Tittle :- "RELATION BETWEEN AEROMYCOFLORA AND LEAF SURFACE MYCOFLORA OF *HIBISCUS SABDARIFFA* (ROSELLE)"

INTRODUCTION

The atmosphere along with gases has dust particles and organic particles like spores of bacteria, fungi and pollens etc which are transported through air current. Air acts as carrier of bioparticles and thus helps in dissemination of these from one place to another. Since Louis Pasteur's practical demonstration of presence of microbes in the air, the hunt for airborne fungi has begun and in the new millennium, it has gathered momentum. Meir (1930) was the first aerobiologists who used the term aerobiology for the studies of airborne fungal spores, pollen grains and other microorganisms. Jacobs (1951) elaborated the term aerobiology for dispersion of fungal spores, bacteria, insects and pollen grains population which become airborne and transported partly or wholly by the environment and their impact on all life belonging forms. Aeromycology has become a very attractive field of interest for many researchers throughout the world in the recent times. Aeromycology is a scientific discipline focused on the transport of airborne spores in outdoor and indoor environments. Fungal spores comprise the greatest portion of suspended biological material in the air. The source of fungal spores and hyphal fragments is often unknown (Gregory, 1973), unlike that of pollen grains, which are easily traced back to their plant species.

The leaf surface has long been considered a hostile environment for fungal colonists. The surface of leaf continuously is exposed to fluctuating temperature and relative humidity, as well as repeated alternation between presence and absence of free moisture due to rain and dew. The surface of leaf also provides limited nutrient resources to fungal colonists. While other habitats probably offer more extreme conditions of desiccation or temperature, etc., they may not be subject to such rapid and extreme fluctuations in these several physical conditions. Several factors may influence the microhabitat experienced by fungi on leaves.

Roselle (*Hibiscus sabdariffa*) is an edible plant used in various applications including foods. Among them, the most popular are the fleshy red calyces used for making wine, juice, jam, syrup, pudding, cakes, ice cream or tea. Roselle flower and calyces is also known for its antiseptic, diuretic, antioxidant and antimutagenic properties (Salleh et al., 2002). The dried flowers of this plant contain gossipetine and hibiscin (anthocyanins); the petals yield glucoside hibiscritin (flavanol); and the calyces are rich in riboflavin, ascorbic acid, niacin, carotene, calcium and iron (Duke, 1983). There for the objective of the present study is to isolate aeromycoflora, leaf surface mycoflora of *Hibiscus sabdariffa* (Roselle) .

REVIEW OF LITERATURE

In the 18th century Pasture proposed his views on microorganisms which became a mile stone in the field of microbiology. This time is also known as golden age of microbiology. According to him air is full of microorganisms and it is responsible for many chemical changes and diseases of human beings and other living organisms. It was Pasture (1861) for the first time made microscopically studies using culture plate technique to demonstrate the presence of airborne microorganisms. In 1873 Cunningham observed microbiological materials of air at Calcutta. Real experimental aerobiology started with experiments of Miqual (1883) who described the volumetric method to analyze microbial population of air. Aerobiology as a term was first introduced by Meier *et al*. (1935). The decades of 1950s and 1960s were of active development in the field of aerobiology. Airospora was the term introduced by Gregory (1961) to describe airborne pollen grains and fungal spores. He published his work in first edition of microbiology of the atmosphere.

The first authentic aerobiological work in India was done by Cunningham (1873) in presidency jail, Calcutta which published his work in the form of a book entitled “Microscopic examination of air” but credit goes to for initiation of aerobiological work in India Mehta (1952) of Agra College, Agra.

AEROMYCOFLORA

Various scientists have studied works on aerobiology in different states and cities. Bernstein and Feinberg (1942) conducted the five year survey of mold spores content of Chicago air. Rajan *et al.* (1952) studied atmospheric fungal flora of Kanpur. Pawsey and Heath (1964) investigated the population of the air at Nottingham. Mishra and Shrivastava (1971) at Gorakhpur II, Ramalingam (1971) at Mysore, Mishra (1972) at Gorakhpur IV, Sandhu and Randhwa (1972) at Amritsar. Chitaley and Bajaj (1973, 1974 and 1975) studied airspora of Nagpur at high altitude I, II and III. Rati and Ramalingam (1976) investigated airborne *Aspergilli* at Mysore. Levetin and Hureuritz (1978) conducted one year survey of the airborne mould of Tulsa, Oklahoma. Agashe *et al.* (1983) studied aeromycoflora of Bangalore. Abdel-Hafez (1984) reported airborne fungus spores at Taif, Saudi Arabia. Singh *et al*. (1986) reported fungi of Lucknow city, a study of two sites suburb of Bombay. Singh and Maninder Kaur (1989) conducted survey of aeromycoflora at Sriganganagar city (Rajasthan). Tiwari (1999) conduted aeromycological studies of Raipur with special reference to fungal spores. Sabariego *et al.* (2000) reported the effect of meterological factors on the daily variation of the airborne fungal spores in Granada, Southern Spain. Devi *et al.* (2002) studied airspora of semiurban area of Gauhati city. Mandal *et al*. (2005) conducted a preliminary report on the aeroplaenology and aeromycology of southern Calcutta (W.B.). Kasprzyk and Worked (2006) investigated airborne fungal spores in urban and rural environments in Poland.

AEROMYCOLOGICAL SURVEY ON LEAF SURFACE MYCOFLORA:

Aerobiological investigation on leaf surface mycoflora has been carried out by Kerling (1964) reported fungi in the Phylloplane of leaves of rye and strawberry. Hogg and Hudson (1966) reported micro fungi on leaves of *Fagus sylvatica*. Tiwari and Sahu (1991) studied on leaf surface mycoflora of *Pisum sativum*. Mishra and Tiwari (1968) studied the plant height as a factor in relation to leaf surface mycoflora of *Cassia tora*. Prasad and Bilgrami (1969) investigated on phyllosphere mycoflora of *Litchi chinensis* in relation to fruit rot. Mishra and

Kanujia (1971) studied on phyllosphere fungi of *Lycopersicum esculentum* in relation to cobalt chloride. Last and Warren (1972) studied non-parasitic microbes colonizing green leaves. Kulkarni *et al.* (1973) studied the Phylloplane mycoflora of some vegetable crops. Kumar and Sinha (1975) studied the phyllosphere mycoflora of wheat and its influence on the development of *Alternaria triticina*. Kumar and Gupta (1976) studied phyllosphere micro flora of three potato varieties in relation to microclimates and meteorological factors. Rai and Singh (1977) studied the leaf surface mycoflora of mustard. Pathak (1979) studied the leaf surface fungi of mango. Dixit and Gupta (1980) studied a comparative study of Phylloplane and airspora of barley. Diem (1974) studied the microorganisms of the barley phyllosphere. Mishra and Dickinson (1981) studied the phylloplane and litter fungi of *Iiexa qualifolium*. Gupta *et al*. (1983) studied a comparative study of airspora and leaf surface mycoflora of chilli. Singh and Khara (1984) studied in vitro inhibition of *Alternaria solani* by phylloplane fungi of tomato. Tiwari and Godheja (1985) studied aerospora and the phylloplane of brinjal at Raipur. Adhikari (1988) studied the phylloplane mycoflora of three grasses of Pithoragarh. Chandel (1990) studied of phylloplane intractions of fungi from soyabean and pigeon pea.

Ayachi and Tiwari (1993) studied on leaf surface microbiology of *Piper betel*. Sahu and Gupta (1995) studied the airmycoflora of Bhilainagar in relation to leaf surface mycoflora of groundnut. Sahu and Tiwari (1994) studied airspora and leaf surface microflora of cauliflower. Tiwari and Sahu (1996) studies on leaf surface mycoflora of *Linum usitatisimum* L. plant. Sharma (2001) studied of aeromycoflora in relation to leaf surface mycoflora of *Ocimum sanctum* Linn. Singh (2006) studied aeromycoflora in relation to leaf surface mycoflora of *Mentha arvensis* Linn. plant. Baraskar and Jogdond (2009) reported impact analysis of biocomponents over Jowar crop environment. Pathare *et al.* (2009) reported atmospheric fungal diversity over sunflower fields.

NOTEWORTHY CONTRIBUTION OF THE PROPOSED WORK

AEROMYCOFLORA & LEAF SURFACE MYCOFLORA

Sahu and Gupta (1995) studied the air mycoflora of Bhilainagar in relation to leaf surface mycoflora of groundnut. Sahu and Tiwari (1994) studied airspora and leaf surface microflora of cauliflower. Tiwari and Sahu (1996) studies on leaf surface mycoflora of *Linum usitatisimum* L. plant. Sharma (2001) studied of aeromycoflora in relation to leaf surface mycoflora of *Ocimum sanctum* Linn.

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Chandel and Pimpalgaonkar (2012) worked on fungal diversity in the phylloplane and rhizosphere of *Jatropha curcus* L. during winter season. Mohobia, (2012) Reported on atmospheric studies of bioaerosoles of Nawapara (Rajim), Distric Raipur with special reference to fungal spores. Shrivastava, (2012) Reported on evaluvation of seed mycoflora of certain oil yielding crops. Saluja ,(2012) Reported on antifungl ctivty of selected medical plants extracts against pathogenic fungi *curvularia lunata*. Lukas, (2013) Reported on aeromycoflora of indoor enviorment of hospital and poultry forms of Bilaspur city.

OBJECTIVE

The aim of this work is to study the aeromycoflora in the fields situated at Paloud (Abhanpur), Raipur, Chhattisgarh (India). The objectives taken are:

1. To isolate the aeromycoflora of selected plant field.
2. To isolate leaf surface mycoflora of *Hibiscus sabdariffa* (Roselle) plant.
3. To find out ecological studies of aeromycoflora and leaf surface mycoflora of selected plant field by calculating-
    i. Percentage frequency.
    ii. Percentage contribution.

METHODOLOGY

STUDY AREA

Abhanpur is a tehsil in Raipur district, Chhattisgarh, India. It is a part of the Naya Raipur Township. It is located at 21°3′10″N 81°44′44″E.My study area situated at Paloud. The methodology for this research work will be as follows:

SURVEY OF AEROMYCOFLORA

For study of aeromycoflora, ten sterilized Petri plates containing PDA media will be exposed for 5 to 10 minutes in the study area. These exposed petri plates will be brought in to the laboratory and will be incubated at 28 ± 1^0C for 6-7 days. At the end of incubation period fungal colonies will be counted, isolated and identified with the help of available literature and will be finally identified by the authentic authority.

ECOLOGICAL STUDY

For ecological studies, at the end of the incubation period percentage frequency and percentage contribution of isolated fungal flora will be calculated (Jadhav *et al*., 1994) with the help of the following formula:

$$\textbf{PERCENTAGE FREQUENCY} = \frac{\text{No. of observation in which a species appeared}}{\text{Total no. of observation}} \times 100$$

$$\textbf{PERCENTAGE CONTRIBUTION} = \frac{\text{Total no. of colonies of individual species in all observation taken together}}{\text{Total no. of colonies in all species}} \times 100$$

ISOLATION OF MYCOFLORA FROM LEAF SURFACE

Leaves of *Hibiscus sabdariffa* (Roselle) will be collected from the study area in sterilized polythene bag with the help of sterilized forceps and brought into laboratory for the isolation of leaf surface mycoflora. The sample leaves will be placed in 150 ml conical flask containing 75 ml of sterilized distilled water. The flask will be shaken by hand for 30 minutes for making homogenous suspension of microorganisms. Prepared suspension will be used for isolation of leaf surface mycoflora. Few drops of this suspension will be poured into each petriplates with the help of micropipette. Then petriplates will be incubated at 28 ± 1^{0}C for 6-7 days. At the end of incubation period the fungal colonies will be counted, isolated and identified with the help of available literature. (Sharma 2001, Saluja 2005, Singh, 2006, Kunjam, 2007 and Lall, 2008).

EXPECTED OUTCOME OF THE PROPOSED WORK

1. It is expected that different fungal species belonging to different fungal genera will be observed from the study area.
2. The ecological study will generate the data of fungal species which will be frequent throughout the study period. This data will also help in finding out the presence of harmful disease causing fungal species.

BIBLIOGRAPHY

Abdel –Hafez, S. I. (1994) : Survey of airborne fungus spores at Taif, Saudi Arabia. *Mycopathologia*., **88 :** 39-44.

Adhikari, A., Bhattacharya, S., and Chanda , S. (1996) : Aero mycology and allergen city of indoor fungal fungal spores in Calcutta during summer season . *Indian Journal of allergy and applied immunology* , **10 (1) :** 11-19.

Adhikari, R. S. (1988) : Phylloplane mycoflora of three grasses of Pithoragarh . *Acta Botanica Indica* **, 16:** 270-272.

Agashe, S. N., Naglakshma, K. V., Chatterjee, M., and Anand, P. (1983) : Aeromycoflora of Bangalore (A Preliminary study) . *Aspergillus Aller*gy *Applied Immunology,* **16 :** 49-52.

Aira, M. J., Jato, V., Stchigel, A. M., Rodriguez- Rajo, F. J., and Piontelli, E. (2007) : Aeromycological study in the Cathedrals of Santiago de Compostela (Spain) . *International Biodeterioration and Biodegradation,* **60(4) :** 231-237.

Ayachi, A. K., and Tiwari, D. P. (1993) : Studies on leaf surface microbiology of *Piper betal* L.II fungal flora of healthy and diseased leaves. *Biome*. **6 :** 11 -18.

Baraskar, S. N., and Jogdand, S. B. (2009) : Impact analysis of biocomponents over jowar crop environment", Abstract 15th Nat. Conf. on Aerobiology and Nat. Symposium on Airspora Impact on Plant, Animal and Human Health. M.U. Imphal. APHC-01, pp 13.

Bernstein, T. B., and Feinberg, S. M. (1942) : A five year daily survey of fungal spore components of the air of Chicago. *Journal of Allergy* , **13 :** 231-241.

Chandel, D. S (1990) : Studies of Phylloplane interactions of fungi from soyabean and pigeon pea . Ph.D. Thesis, Pt. R. S. U. Raipur.

Chitaley, S. D., and Bajaj, A. (1974) : "Airspora of Nagpur at high altitude II. *Botanique,* **5 :** 43-52.

Chitaley, S. D., and Bajaj, A. (1973) : Airspora of Nagpur at high altitude I. *Botanique*, **4 :** 27-34.

Chitaley, S. D., and Bajaj, A. (1975) : Airspora of Nagpur at high altitude III . *Botanique*, 6, pp 59-68.

Chitnavis, S., and Khillare, C. J. (1994) : Aerobiological studies of seed godown in Kolhapur (M. S.) India. In Aerobiology 5th Int. Congr. Aerobiol.; Bangalore Proc. (ed. S. N. Agashe).

Cunningham, D. D. (1873) : Microscopic examination of air. Govt. Printers, Calcutta. **:** 58.

Devi, N., Dhar, B., and Sarma, G. C. (2002) : Airspora of semi urban area of Gawahati city. *Indian Journal Aerobiology* , **15(1&2) :** 20-31.

Diem, H. G. (1974) : Microorganisms of the leaf surface estimation of the micro flora of the barley phyllosphere. *Journal* of *general Microbiology*, **80 :** 77 -83.

Dixit , R. B., and Gupta , J. S. (1980) : A comparative study of Phylloplane airspora of barley. *Indian-Phytopathology,* **33(2) :** 311-312.

Duke, A. (1983) : *Hibiscus sabdariffa* L. Handbook of Energy Crops.

Emberlin , J., Newman, T., and Bryant , R. (1995) : Incidence of fungal spores in the ambient air and inside homes: Evidence from London. *Aerobiologia,* **11(4) :** 253-258.

Gravesan , S. (1972) : Identification of indoor airborne micro fungi during twelve months from forty four Danish homes. *Acta Allergol* , **27 :** 327-354.

Green ,V. B., Vesley, D. B., Bond, R. G., and Michelson , M. (1962) : Microbiological contamination of hospital air II. Quantitative studies. *Journal of Applied Microbiology* , **10 (6) :** 567-571.

Gregory, P. H. (1961) : The microbiology of the atmosphere. Leonard Hill (books) Ltd. Inter Science Publishers INC New York, pp 233.

Gregory, P. H. (1973) : The microbiology of the atmosphere", Leonard-Hill, Great Britain, pp 377.

Jadhav, S. K., and Lall, B. M. (2009) : Ecological studies of indoor aeromycoflora of Dr. Bhim Rao Ambedkar Hospital, Raipur, Abstract, 15th Nat. Conf. on Aerobiology and National Symposium on Airspora- Impact on Plant, Animal and Human Health. M. U. Imphal. ATGASAS-30, pp 46.

Jadhav, S. K., Tiwari, K. L., Sahu, K., and Verma, S. (1996) : Aerobiological studies of Chemistry lab of Govt. College Balodabazar, Raipur. Abst. 8th Nat. Conf. Aerobiol. Poona, pp 44.

Kasprzyk, I., and Worek, M. (2006) : Airborne fungal spores in urban and rural environments in Poland. *Aerobiologia,* **22(3) :** 169-176.

Kumar, R., and Gupta, J. S. (1976) : Phyllosphere microflora of three potato varieties in collation to microclimate and meteorological fectors. *Phytopathology*, **29 :** 164-168.

Lall, B. M. (2008) : Studies of indoor and outdoor aeromycoflora of Dr. Bhim Rao Ambedkar hospital Raipur (C. G.). Ph.D. Thsis, Pt. R. S. U. Raipur (C. G.).

Last, F. T., and Warren, R. C. (1972) : Non-parasitic microbes colonizing green leaves. Their form and function. *Journal of Endeavour*, **31:** 143-150.

Levetin, E., and Hurewitz, L. (1978) : A one year survey of the airborne mould in Tulsa, Oklahoma, outdoor survey. *Annals Allergy*, **41 :** 21-24.

Lukas, R. (2013) : Studies of aeromycoflora of indoor enviorment of hospital and poultry forms of Bilaspur city. Ph.D. Thsis, Pt. R. S. U. Raipur (C. G.).

Mandal, J., Chanda, S., and Gupta Bhattacharya, S. (2005) : A preliminary report on the aeropalynology and aeromycology of Southern Calcutta, West Bengal. Abst. 13th Nat. Conference of Aerobiology , Nagpur, pp 9.

Mehta, K. C. (2005) : Further studies on cereal rusts of India –II Sci. Monograph. 18 Coun. *Indian Agricultural Research* , New Delhi, India, : 1-368.

Meier, F. C. (1935) : Collecting microorganisms from the Arctic atmosphere. *Science*, New York **40 :** 5-20.

Mishra, R. R. (1972) : Aeromycology of Gorakhpur IV, periodical fluctuations of airspora. *Mycopathology Mycology Applied* , **48**: 213-222.

Mishra, R. R., and Dickinson, C. H. (1981) : Phylloplane and litter fungi of Iiexa qualifolium. *Transactions of the British Mycological Society* , **77(2) :** 329-337.

Mishra, R. R., and Kanujia. (1971) : Studies on phyllosphere fungi III. Leaf surface fungi of healthy and virus infected Lycopersicum esculentum in relation to cobalt chloride. *Sydoewia Annual Myco*logy *Series,* **2 :** 1-6.

Mishra, R. R., and Srivastava, V. S. (1971) : Aeromycoflora of Gorakhpur II, spore content over a paddy field. *Mycopathology* , **44(3) :** 282-288.

Mishra, R. R., and Tiwari, R. P. (1968) : Plant height as a factor in relation to leaf surface mycoflora of *Cassia tora*. Nat. Acad. Sci. India Annual No.6.

Mohobia, R. (2012) : Atmospheric studies of bioaerosoles of Nawapara (Rajim), Districc Raipur with special reference to fungal spores. Ph.D. Thsis, Pt. R. S. U. Raipur (C. G.).

Pathak, N. (1979) : Studies on leaf surface fungi of mango. Ph.D. Thesis University of Sauger.

Pathare, G. M., Mali, V. P., and Pande, B. N. (2009) : Atmospheric fungal diversity over sunflower fields. Abstract, 15th Nat. Conf. on Aerobiology and National Symosium on Airspora Impact on Plant, Animal and Human Health M. U. Imphal. APHC-03, pp 14.

Pawsey, R. G., and heath, L. A. F. (1964) : An investigation of the spore population of the air at Nottingham. *Journal of Transaction British Mycolology Society*, **47 :** 351-355.

Pei- Chin, Wu., Hueyjan, S., Jenny, Su., and Hsiao- Man, Ho. (2000) : Characteristics of indoor and outdoor airborne fungi at suburban and urban homes in two seasons. *Science Total Environment* , **253 :** 111-118.

Prasad, S. S., and Bilgrami, R. S. (1969) : Investigations on disease of litchi - I Phyllosphere mycoflora of *Litchi chinensis* in relation to fruit rot. *Indian Phytopathology*, **22 :** 507-510.

Rai, B., and Singh, D. B. (1977) : Leaf surface mycoflora of mustard. (Abst.) *Supplement Acta Botanica* ,**5(2) :** 21-22.

Sabariego, S., Diez, De. La., Guardia, C., and Alba, F. (2000) : The effect of meteorological factors on the daily variation of airborne fungal spores in Granada (Southern Spain). *International Journal of Biometeorology* . **44(1) :** 1-5.

Sahu, S. K., and Gupta, U. (1995) : Air mycoflora of Bhilainagar in relation to leaf surface mycoflora of groundnut. *Geobios New Reports,* **14 (2) :** 235-239.

Sahu, S. K., and Tiwari, K. L. (1994) : Airspora and leaf surface mycoflora of cauliflower (*Brassica oleracea* var. *botrytis*) at Raipur. *Advance Plant Science* , **7(2) :** 203-211

Sandhu, D. K., and Randhawa, I. S. (1972) : Studies on the airborne fungal spores at Amritsar, their role in keratomycosis. *Mycopathology,* **68 :** 47 -52.

Sharma, K. (2001) : Studies of aeromycoflora in relation to leaf surface mycoflora of *Ocimum sanctum* Linn plant. Ph.D. Thsis, Pt. R. S. U., Raipur (C.G.).

Singh, B. P., and Kaur, M. (1989) : Survey of Aeromycoflora at Sriganganagar city (Rajasthan). *Journal of Palynology,* **25 :** 25-43.

Singh, B. P., Nath, P., and Mukherjee, P. K. (1986) : Airborne fungi of Lucknow city a study of two sites. *Indian Journal of Chest Diseases & Allied Sciences* **, 22(4) :** 199-203.

Singh, J. and Khara ,H. S. (1984) : In vitro inhibition of *Alternaria solani* by Phylloplane fungi of tomato. *Indian Phytopathology* , **37(3) :** 579

Singh, N. B. (2006) : Studies of aeromycoflora in relation to leaf surface mycoflora of *Mentha arvensis* Linn. Ph.D. Thsis, Pt. R. S. U., Raipur (C.G.).

Sharma, S. (2011) : Charactestics of symbiotic , biochemical and physiological abilities of some rizobium species. Ph.D. Thsis, Pt. R. S. U., Raipur (C.G.).

Shrivastava, P. (2012) : Evaluvation of seed mycoflora of certain oil yielding crops. Ph.D. Thsis, Pt. R. S. U., Raipur (C.G.).

Tilak, S. T., Pillai, S. G., and Saibaba, M. (1981) : Components of airspora inside the library and its relevance to book deterioration. Proc. Nat. Conf. Env. Biol, : 173-177.

Tiwari, K. L., and Godheja, A. (1985) : Airspora and the Phylloplane of Brinjal at Raipur. *Journal of Botanical Research*, **1:** 149-152.

Tiwari, K. L., Jadhav, S. K., and Harwani, Y. (2009) : Biodiversity of the aerofungi of library-I Abstract, 15th Nat. Conf. on Aerobiology and National Symposium on Airspora-Impact on Plant, Animal and Human Health M. U. Imphal. ATGASAS-05, pp 47.

Tiwari, P. (1999) : Aerobiological studies of Raipur with special reference to fungal spores. Ph.D. Thsis Pt. R. S. U. Raipur (M. P.).

Tripathi ,R. N. (1987) : Fungal airspora inside the central library of Gorakhpur University. *Water, air and soil pollution*, **34 :** 125-134.

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